DOCUMENT RESUME

ED 227 409 CG 016 541

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TITLE An Analysis of Information Integration Using Free Response Data.
INSTITUTION Battelle Human Affairs Research Centers, Seattle, WA.
REPORT NO BHARC-400-82-006
PUB DATE Aug 82
NOTE 16p.; Paper presented at the Annual Convention of the American Psychological Association (90th, Washington, DC, August 23-27, 1982).
AVAILABLE FROM Michael K. Lindell, Battelle Human Affairs Research Centers, 4000 N.E. 41st Street, Seattle, WA 98105.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Attitude Measures; *Cognitive Style; Comparative Testing; Decision Making; Evaluation Criteria; *Evaluative Thinking; Integrated Activities; Nuclear Energy; *Predictor Variables; *Social Cognition
IDENTIFIERS Free Response Test Items; *Information Integration

ABSTRACT

A number of laboratory studies have addressed the question of how people integrate different pieces of information to form an overall evaluative judgment. Models of information integration, i.e., the adding model and the averaging model, were tested by gathering questionnaire data from 233 respondents in 17 groups who were expected to vary in their attitudes from strongly pro-nuclear to strongly anti-nuclear. The adding model predicted that a larger number of evaluatively consistent cognitions would be associated with more extreme attitudes. The averaging model predicted that one positive cognition would produce a more extreme attitude than the combination of one negative and two positive cognitions. Data analyses confirmed the prediction of the adding model. Among subjects who held all evaluatively consistent cognitions, a larger number of cognitions were associated with significantly more extreme attitudes. No support was found for the averaging model, suggesting it does not generalize well to a nonlaboratory situation in which subjects are asked to provide traits that they associate with a familiar stimulus. Further research is needed to identify the conditions under which diffeent integration models apply. (JAC)

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BHARC-400/82/006

An Analysis of Information Integration Using Free Response Data

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CG 016541

Abstract

Two models of information integration were tested on questionnaire data collected from 233 respondents in seventeen groups ranging from strongly pro- to strongly anti-nuclear. The adding model predicts that a larger number of evaluatively consistent cognitions would be associated with more extreme attitudes. The averaging model predicts that one positive cognition would produce a more extreme attitude than the combination of one negative and two positive cognitions. The prediction of the adding model was confirmed; the prediction of the averaging model was not. In view of the significant procedural differences between this study and those that have supported the averaging model, further research is needed to identify the conditions under which different integration models apply.

An Analysis of Information Integration Using Free Response Data

A number of laboratory studies have addressed the question of how people integrate different pieces of information to form an overall evaluative judgment. An "averaging" model of information integration states that people average the values of different pieces of information to form an overall judgment, whereas an "adding" model states that people add the values. Most experimental tests of averaging vs. adding models have tended to support an averaging model (Anderson, 1965, 1968; Hendrick, 1968; Oden and Anderson, 1971; Singh, Gupta and Dalal, 1979). Research has repeatedly demonstrated that experimental presentation of four extreme traits produces more extreme attitudes than presentation of two traits, (a "set size effect") even if the average value of the set of information remains constant (e.g., Anderson, 1965). However, this apparent support for the adding model has been incorporated into the averaging model by assuming an initial neutral impression which is incorporated into the overall judgment. Such an explanation is supported by the "decelerating set-size effect." Several studies (Anderson, 1965, 1967, 1968; Anderson and Birnbaum, 1976; Sloan and Ostrom, 1974) have shown that the effect of each piece of additional information on overall attitude decreases as the total number of items of information increases. This effect could not be explained by the adding model, unless, as Gollob, Rossman and Abelson (1973) and Yamagishi and Hill (1981) suggest, one takes redundancy in the information into account.

The assumption of an initial neutral impression is plausible in the context in which previous research has been conducted--experimenter controlled presentation of multiple trait profiles of hypothetical objects. However, an initial neutral impression may well be forgotten in judgments of familiar stimuli, especially when information about the object is gained over an extended period of time. If the set size effect were found in a situation in which the assumption of an initial neutral impression seemed implausible this would cast doubt on the generalizability of the averaging model. Such a test could be provided by examining the relationship between cognitive constructs (traits) and attitudinal judgments about a familiar object when the traits were elicited from subjects in a free response format, rather than presented to them in multiple trait profiles. Indeed, Fishbein and Ajzen have suggested "... that an adequate measure of salient beliefs would require each subject to list his beliefs ... (1975, p. 235)." Such a procedure would have the advantages of eliminating the neutral initial impression, assuring that only subjectively relevant traits entered the analysis, and controlling the problem of respondent making inferences about traits not presented from those traits that are presented (trait implication).

It is important to explain how and why the two models make differential predictions in this situation. The adding model would predict that among people who hold all evaluatively consistent (that is, all positive or all negative) cognitions, a larger number of constructs would be associated with more extreme attitudes while the averaging model would predict equally extreme attitudes. This assertion follows directly from the formulations of the two

models. When there is no initial neutral impression, Anderson's (1981) statement of the averaging model reduces to

$$Y_n = \Sigma w_i X_i / \Sigma w_i.$$

This implies that for all $w_i > 0$, Y_n (the overall attitude for a respondent supplying $\underline{n}$ traits) will always fall into the interval $X_1 < Y_n < X_n$ where X_n is (arbitrarily) defined to be the trait with the greatest evaluative extremity. In other words, the magnitude of the overall attitude lies somewhere between the least and most extreme trait.

The adding model would be expressed as

$$Y_n = \Sigma w_i X_i$$

This implies that for all $w_i > 0$, Y_n will always exceed X_n, the most extreme trait.

If respondents are asked to nominate traits that they consider relevant, the w_i should all be high and approximately equal. Moreover, the traits supplied by each respondent can be thought of as being drawn from a pool of traits, the most available (see Tversky and Kahneman, 1973 for a discussion of the availability heuristic in inference processes) being drawn first, and less extreme traits being drawn subsequently. These conditions closely approximate those described by Fishbein and Ajzen (1975, p. 232) as Case 1. In its strictest interpretation, Case 1 applies only when $X_i = X_j$, for all $\underline{i}$, $\underline{j}$. In such a case, averaging predicts $Y_1 = Y_2 = \ldots = Y_n$. If the most extreme traits are nominated first, then the averaging model predicts $Y_1 > Y_2 > \ldots > Y_n$. In either case, the adding model predicts $Y_1 < Y_2 < \ldots < Y_n$. If one presumes that the cognitive search process described for the

evaluatively consistent respondents is used also by the evaluatively nonconsistent respondents, then the averaging model would suggest that $Y_1 > Y_3$. As a specific example, suppose that all cognitions have $w_i = 1$ and $X_i = 1$. The averaging model yields

$$Y_3 = \frac{(1)(1)+(1)(1)+(1)(1)}{3} = \frac{1}{3} \text{ and } Y_1 = \frac{(1)(1)}{1} = 1.$$

The adding model predicts

$$Y_3 = (1)(1)+(1)(1)+(1)(-1) = 1 \text{ and } Y_1 = (1)(1) = 1.$$

It is important to note than an object with positive and negative traits (termed "ambivalent" by Scott, Osgood and Peterson, 1979, p. 63) provides a very robust test of adding vs averaging. Even large deviations from the presumed values of the w_i and X_i would still yield differential predictions for the two models.

METHODS

Subjects In order to obtain a sample representing a broad range of attitudes, data were collected from 233 members of 17 groups, who were expected to vary in their attitudes from strongly pro-nuclear to strongly anti-nuclear. Pro-nuclear (for example, nuclear engineers), neutral (computer programmers) and anti-nuclear (Sierra Club) groups were surveyed in five states (Massachusetts, Illinois, Texas, Colorado and California). A list of the groups which were selected, expected attitudes, and demographic characteristics of the groups including sex, age, education and income are reported in Lindell, Earle, Hebert and Perry (Note 1).

Questionnaire The questionnaire was part of a larger study with a rather broad focus of measuring public attitudes toward a number of energy issues. Of interest here are measures of the number of cognitions, evaluative consistency, and extremity of attitudes toward nuclear power. This is an appropriate attitude object for this study since it has been a controversial public issue for the last decade. Consequently, any initial neutral impression has probably lost its salience for most people.

Cognitive Complexity and Evaluative Consistency. Subjects were asked to provide, in a free-response format, several cognitions about nuclear power. Instructions stated that respondents were to write on each line a word or short phrase which they associated with that technology. Three spaces were provided. This measure was taken early in the questionnaire so that later questions would not suggest dimensions to subjects.

In order to code the items, the experimenters identified a number of issues that could be considered to distinguish alternative energy sources (health and safety, environment, aesthetic, waste/general, reliability, efficiency, feasibility, fuel availability, cost, centralization, applicability, level of technology, state of development, public knowledge, and global evaluation). Each response was rated as to its cognitive content (which issue was mentioned) and its evaluative content (the direction, positive or negative, in which the judgment was made). For example, the response "expensive to operate" was coded as a negative response in the category of cost. The judgments of both cognitive and evaluative components were made by an experimenter who was uninformed about the specific hypotheses to be

tested. Reliability of the ratings was established by having another experimenter independently rate 50 of the responses; there was a 90% rate of agreement.

The number of cognitions held by an individual was determined by counting the number of different categories mentioned by that individual. Eight of the respondents provided more responses than the number of spaces provided, and were assigned the maximum score of three. Ratings of the evaluative component were used to construct the measure of evaluative consistency. This was a dichotomous variable in which one level represented all evaluatively consistent responses (all positive or negative) and the other level indicated at least one nonconsistent response.

Attitude Extremity. The measure of attitude extremity was formed from three Likert items located toward the end of the questionnaire that measured attitudes toward nuclear power on seven-point bipolar scales. These items were "We should not build more nuclear power plants until a highly effective waste disposal system has been developed and thoroughly evaluated," "Based on past operating experience, nuclear energy has been demonstrated to be a clean and safe source of electrical power," and "To substitute for diminishing supplies of alternative sources, the United States will need additional nuclear plants even if there is no growth in the demand for electricity." These items were reverse-scored where necessary and summed to form a scale of attitude toward nuclear power. This scale was transformed into a measure of attitude extremity by taking the most extreme responses from each end of the scale and considering them the highest level of extremity, then the next most

extreme responses, and so forth. This yielded a five-point extremity scale with approximately equal numbers of subjects at each level.

RESULTS

The adding model predicts that among people who held evaluatively consistent cognitions (all of the same sign), a larger number of cognitions would be associated with more extreme attitudes. The averaging model predicts that respondents with one cognition would have more extreme attitudes than those with three cognitions when two are of the same sign and the third is of the reverse sign. One-way ANOVAs were performed to test these predictions.

Adding. A one-way ANOVA was performed using those subjects (n = 143) whose cognitions were evaluatively consistent. The independent variable was the number of cognitions (1, 2 or 3) and the dependent variable was attitude extremity (measured on a five-point scale, with 1 indicating maximum extremity). The effect of the number of cognitions was significant, $F(2,140) = 4.119$, $p < .0183$, and in the predicted direction (means were 3.2, 2.8 and 2.3 for 1, 2 and 3 cognitions respectively). It is interesting that there was a slight tendency toward an accelerating set size effect (e.g., the difference between 3 and 2 cognitions was greater than the difference between 2 and 1 cognitions) although the trend was not statistically significant.

Averaging. A one-way ANOVA was performed using subjects (n = 83) who held either one cognition or three cognitions of which two were of the same sign and the other was of the reverse sign. These two groups did not differ from each other, $F(1,81) < .1$, n.s. Means were slightly in the direction opposite to

the prediction of the averaging model (means were 3.2 and 3.1 for one cognition and three cognitions, respectively).

An attempt to infer support for one model from a failure to reject another model can be a problematic procedure. In the present instance, the failure to find a statistically significant effect predicted by the averaging model could be due to inadequate statistical power associated with the test itself. Since the sample sizes of the two tests were so different--n=143 for the test of adding and n=83 for the test of averaging--a further analysis was conducted performed to determine the "effective alternative hypothesis" (Bailey, 1971, p. 388). This post-analysis indicates the size of the effect which could be expected to be detected by an analysis with reasonable Type I and Type II error probabilities. The formula $n = \frac{2\sigma^2}{\delta^2}(z_\alpha + z_\beta)$ was used Edwards (1972, p. 91). Setting both α and β at .05 (a conservative value of β), and using the actual sample size (83) and variance (2.31), the obtained difference ($\Delta = X_1 - X_2$) is approximately .9. That is, a difference between means of approximately .9 could be expected to be detected with probability, $\pi = .95$. This is the same magnitude as the difference between the largest and smallest means of the groups used in the test of the adding model, suggesting that if an effect of similar magnitude had existed in the test of the averaging model, it probably would have been detected.

DISCUSSION

Results of the present study were consistent with predictions derived from the adding model of information integration. Among subjects who held all evaluatively consistent cognitions, a larger number of cognitions was

associated with significantly more extreme attitudes. No support was found for the averaging model. These results suggest that the averaging model which better accounts for integration processes during experimenter controlled presentation of trait profiles of hypothetical objects does not generalize well to a nonlaboratory situation in which subjects are asked to provide traits that they associate with a familiar stimulus. In this situation, the adding model is better able to account for the observed relationships. These data do not imply--nor are we concluding--that the adding model of information integration is superior to the averaging model in any situation other than the one we have studied. Rather, these data,--together with those of past studies in this area--suggest that both models are incomplete representations of the information integration process.

Yamagishi and Hill (1981) recently proposed a path-analytic model of information integration, that is a significant improvement on both the adding and averaging models. The PAI model, which is a more general mathematical formulation than either the adding or averaging models, takes into account non-independence of the pieces of information. Since the present study collected no data were collected on respondents' perceptions of the independence of their response categories, it was not possible to test any differences between the additive and PAI models. However, future research should carefully consider the relationships among all three models: adding, averaging and PAI.

In seeking to reconcile the differences between the results of the present study with those of the many previous studies that have supported the averaging

model, it should be noted that there are four major procedural differences. First, many of the previous studies have used presentation of experimenter-determined dimensions rather than collection of respondent-determined dimensions. Second, the dependent variable in the present study was a Likert scale which could be considered to be less susceptible to floor or ceiling effects than would unidimensional response scales (c.f. Yamagishi and Hill, 1981). Third, the cognitive data and the attitude scale were located in separate sections of the questionnaire. This procedure minimized respondents' awareness of the researchers' interest in the connection between the two sets of data and, thus, reduced the "reactivity" (Campbell & Stanley, 1963) of the measurement process. Last, an attitude object was used that a number of respondents considered to be "ambivalent." To assess the influence of each of these factors in determining the obtained results, further research is needed.

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1. Lindell, M. K., Earle, T. C., Hebert, J. A. & Perry, R. W. Radioactive wastes: Public attitudes toward disposal facilities. Seattle, WA: Battelle Human Affairs Research Centers, 1978.

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